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ABSTRACT

The problem-solving process has contributed greatly to the field of technology education and can be used to assist persons with disabilities. One problem-solving design that can help in working with persons with disabilities is the "Engineering for Success" design. This model groups technology education students with teachers of special education so that both groups learn how to develop high quality products through the incorporation of knowledge from their respective fields and from the "Engineering for Success" design. In addition, this model assists occupational therapy students in learning the problem-solving skills they need to help people with temporary disabilities to recover from an injury or illness. Faculty and teaching associates at The Ohio State University have found the "Engineering for Success" design to be successful. (Contains 10 references.) (KC)

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The Utilization of Problem Solving for the Disabled

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Introduction

The nature of technology education in our society is constantly changing, and with these changes come the problems and challenges of developing effective curricula and instruction. One technology education instructional strategy that has been effective for several decades is that of problem solving.

This presentation will present a brief background of problem solving in technology education, followed by discussion of how problem solving in technology education can assist teachers of students with disabilities and people working with permanent and temporarily disabled populations. Finally, some practical applications will present how teachers can incorporate problem solving into an effective instructional approach for students with disabilities.

Background of Problem Solving

The background of problem solving includes research performed by Bosworth & Savage (1994), Brown, Collins, & Duguid (1989), Cote (1984), Johnson (1988), Maley (1972), and Pedras & Braukmann (1990) among others.

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John Dewey was able to recognize the significance of defining a problem prior to being able to explain the problem solving thought process. One of the first technology education models of problem solving that followed Dewey's theory was the Maryland Plan (Maley, 1969).

Another problem solving strategy that students and teachers could use in technology education curricula is the Difference-Reduction Method. This method is most often used in combination with the Means-Ends Analysis method (discussed in the next section) to solve a problem (Pedras & Braukmann, 1990).

According to Johnson (1988), instructors sometimes try to eliminate difficulties for the students by structuring the problem to insure success. However, this action deprives students of prime problem solving opportunities associated with an ill-structured problem.

The three main theories behind the problem solving process include the cognitive science theory (Johnson & Thomas, 1994), the general human behavior theory, and the theory of expert problem solving behavior (Johnson, 1988).

According to Bosworth III & Savage (1994), the process of problem solving should be included in every curriculum in the field of Technology Education. However, for problem solving to be effective, the technology education program must have an environment that assists and encourages problem solving.

Application of Problem Solving strategies to students with disabilities

Technology education is a challenging and changing field with a diverse set of instructional strategies. One approach that could assist technology education teachers in their quest for instructional solutions is problem solving as it relates to teachers of people with disabilities. The implementation of technology education problem solving with the needs of students with disabilities will require changes in the ways that teachers structure activities for students and the manner in which teachers provide instruction. There is also a strong possibility that there will be some change in the content and sequence of instructional material, in a way which requires teachers to group disabled and non-disabled students together for learning, problem solving, and evaluation. These changes do not need to be overly demanding, but structured so they will work well within an existing program. Prior to implementing such an approach at the middle or high school level, teachers should have some prior training on orientation to such approaches. How is this done? What follows is a teacher training model used at our institution.

A Teacher Training Model

One of the goals of The Ohio State University's Technology Education program is to help train prospective teachers and other professionals working with the disabled populations to develop problem solving skills. These persons come from the occupational therapy, special education, and technology education fields. Occupational therapy and special education persons bring a knowledge base of the concerns of people with disabilities. Technology education students bring their knowledge of technology to the group.

The training of these college students is performed through a "practical application" approach. This approach focuses on helping the student to solve a specific problem related to disabled people through a problem solving approach. Some people have trouble with mobility, dexterity, or coordination. Other people have sensory problems (i.e., hearing, sight, etc.). All of these people need assistance to perform even the simplest tasks. It is the goal of the students in these fields to assist disabled populations to become more independent.

There are two primary courses in the OSU technology education program that provide the education mentioned earlier; a graduate level problem-solving course for people working with disabled populations, and an undergraduate level course for

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occupational therapy students. The primary part of each course's curriculum is the problem solving approach, "Engineering for Success" (see figure 1).

This approach, [adapted from Gugerty, Roshal, Tradewell, & Anthony (1981) and designed by Dr. Michael L. Scott and funded by the Ohio Education Deans' Task Force for Personnel Preparation for the Handicapped] can be used with students working individually or in groups. The goal of the approach is for the participants to solve a problem in the disabled population through an engineering approach utilizing the knowledge of teachers of special education students, technology education students, and occupational therapy students.

The steps of the Engineering for Success problem solving design are outlined in figure 1. These steps include:

- Identify the design problem.
- Identify the disabled condition to overcome.
- List all possible solutions.
- Select best solution.
- Develop prototype.
- Test prototype.
- Make modifications and retest (optional).
- Determine degree of success.

Figure 1: Part 1 of 2, Engineering for Success.

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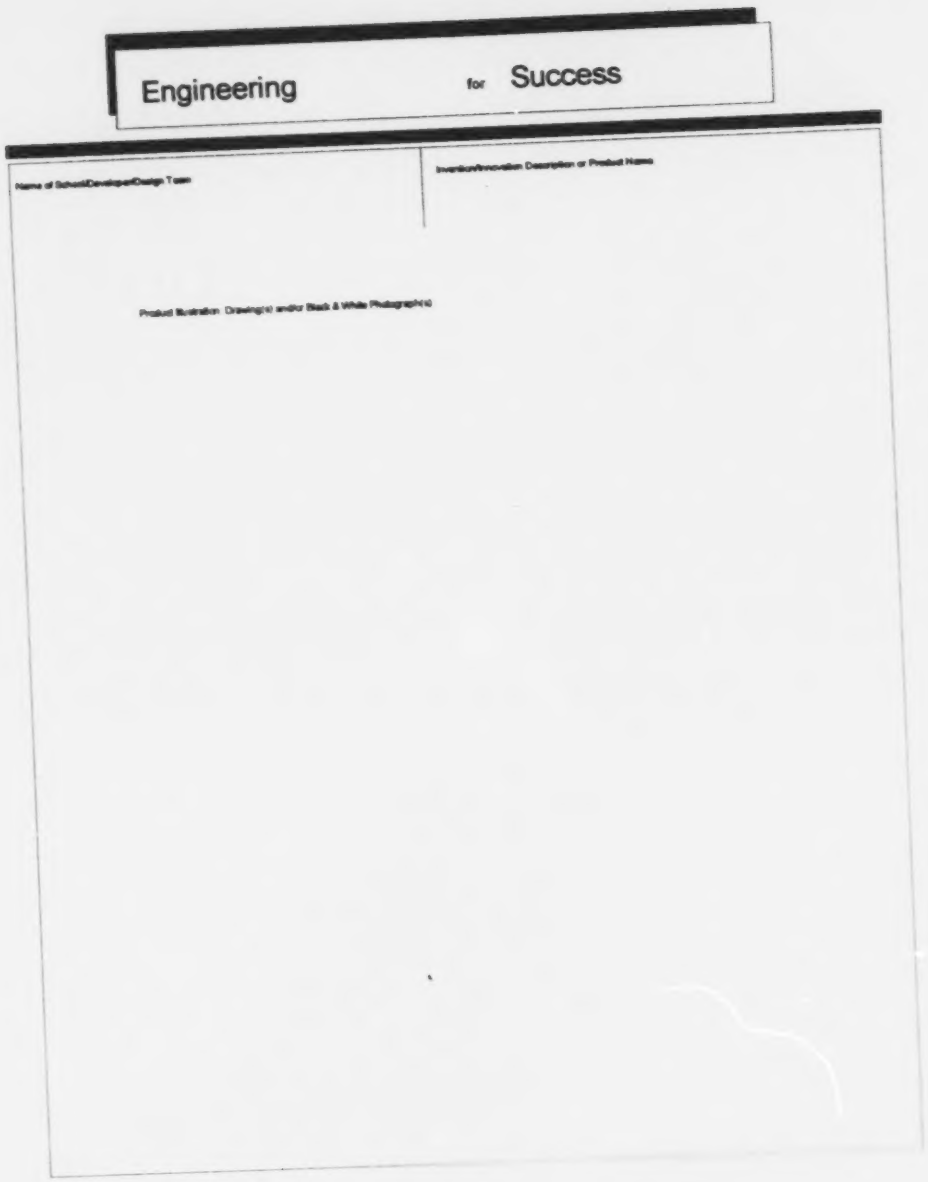

Figure 1: Part 2 of 2, Engineering for Success.

At The Ohio State University, the professors and teaching associates have used this design in undergraduate and graduate courses to help technology education students, teachers of

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special education students, and occupational therapy students to solve problems regarding the physically impaired. First we will discuss how the Engineering for Success design is used with technology education students and teachers of special education students. Then we will discuss how this design is being used with occupational therapy students enrolled in technology education courses at OSU.

The students in the technology education graduate level course come from a technology education or special education teaching background. These students are encouraged to work in teams on projects that help permanently disabled populations.

There are some definite observed differences in the results of projects developed by teams having technology education students and teachers of special education students verses teams with only technology education students or only teachers of special education students. It would appear that the products produced by the teams having both kinds of students clearly focus on a disability problem, and are developed from sound problem solving principles resulting in a high quality, useful product. However, the teams having only technology education students lack a focus on disabled populations while teams having only teachers of special education students have difficulty solving quality or reliability problems.

One example of the Engineering for Success design in action is a product developed by a design team of technology education students and teachers of special education students. This team noticed that many disabled people who used a computerized communication board as their only means of communication needed a means of transporting the device so that it would be accessible for immediate use, and yet not be cumbersome to carry. They observed that, while people could use the communication device effectively in their lap in a seated position, they had difficulty holding the communication device for communication while standing, shaking hands, going through lunch lines, or while doing other things with their arms and hands.

The design team made a list of possible solutions that included using a wooden tray to support the device, and using leather straps to hold the communication device while standing. These solutions were eventually incorporated into the final design. After developing a prototype and then testing, modifying, and retesting the device, the team found the final product to be satisfactory (see figure 2).

Figure 2: Communicator & harness.

Another example of the Engineering for Success design in action is a safety device that was developed to help developmentally handicapped elementary students safely use a paper trimmer to cut paper for making note pads. This product was also developed by a design team of technology education students and teachers of special education students. For the paper trimmer to be safe, both hands needed to be in use to operate the device

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so that there would be little chance that a hand or finger could be under the blade arm.

The design team made a list of possible solutions that included using a bicycle brake handle and cable to release a

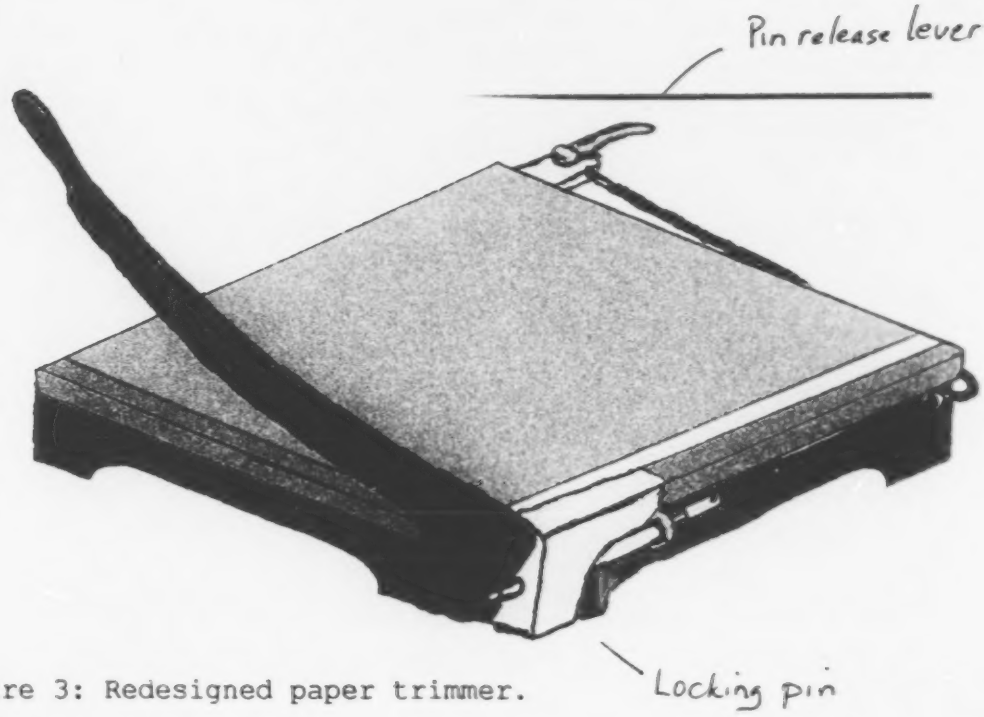

Figure 3: Redesigned paper trimmer.

locking mechanism. After making a prototype and testing, modifying, and retesting the device, the team agreed the final product was satisfactory (see figure 3). The device locks the blade arm up when a pin enters a slot behind the back of the blade arm. The student must pull a lever (using his or her left hand) to release the pin, enabling the blade arm to be operated

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with the right arm. This design prevents the student from cutting a hand or finger while operating the paper trimmer.

The above designs are solutions to problems associated with permanent physical disabilities that try to provide disabled people with technological devices that make particular activities easier to perform. The problems that permanently disabled persons face are usually associated with daily or special tasks. These tasks can be made easier through the development of technological devices.

Also associated with disabled populations are occupational therapy (OT) students, who deal with the rehabilitation of temporarily disabled people. The OT students at OSU are required to take two handicrafts courses from the technology education program that help the students learn how to solve problems they may encounter in the OT field through the development of devices that assist injured or sick people to recover more quickly. The following paragraphs discuss two problems that OT students face when trying to assist people to recover from an injury or illness and the solutions to those problems.

Following a head injury, most people have difficulty controlling their hand-eye coordination during simple tasks such as writing, grasping and holding objects, or moving things with their hands. The devices best suited to assist injured people during recovery include sorting trays, checker boards, and wooden

peg sorters. One example of OT students using the Engineering for Success design to assist injury patients is a wooden peg sorter developed by an OSU OT student (figure 4). This device helps the head-injury patient to develop hand-eye coordination skills along with logic and critical thinking skills through sorting, moving, and inserting the pegs in the proper holes.

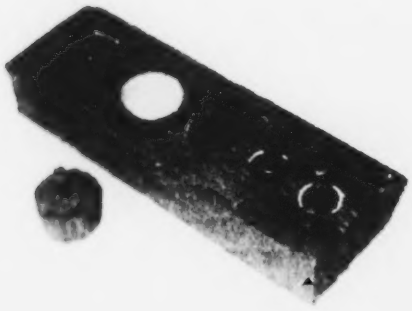

Figure 4: Wooden peg sorter.

A second example of OT students using the Engineering for Success design involved the development of a device to assist stroke patients to regain their mobility skills and logical thinking abilities. One solution by an OSU OT student using the

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Engineering for Success design was a wooden puzzle (figure 5). This device is used by OT professionals in their field to assist stroke patients to develop their mobility and logical thinking ability through the arrangement and assembly of the various puzzle pieces.

Figure 5: Puzzle.

Through the problem solving process incorporated in the Engineering for Success design, OT students as well as special needs teachers can develop the problem solving skills they need to assist temporarily disabled and permanently disabled people to either recover from their disability or make their lives a little easier in spite of their disability.

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Problem solving activities can greatly enhance a program that incorporates technology education, special education, and occupational therapy students in an instructional setting. The knowledge and experience the students gain will likely help them in assisting disabled populations in their respective fields.

Conclusion

The problem solving process has contributed greatly to the field of technology education, and can be used to assist those in the disabled population. One problem solving design that can help students and teachers working with disabled people is the Engineering for Success design. This design tries to group technology education students with teachers of special education students in order to teach them how to develop quality products through the incorporation of the knowledge from their respective fields and the Engineering for Success design. In addition, this design assists OT students to learn the problem solving skills they need to help temporarily disabled people recover from an injury or illness. As faculty and teaching associates at The Ohio State University, we have found this design to be successful, and recommend this design to others interested in assisting disabled populations.

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